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New Methods for Detection of Fish Populations or Mapping of Fish Habitat

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LONG-TERM GOALS

The overall objective of this work is to develop and test a new technique to detect and map epipelagic fishes and their habitat in the EEZ of Oregon and Washington. The technique combines data from satellites, aircraft, ships, and moorings. Each platform covers a unique set of spatial and temporal scales, and each instrument has its own advantages and disadvantages. A technique combining data from multiple platforms can be much more powerful than any one alone. The secondary objective is the analyze the array of spatial data collected to better understand the connection and affects of habitat and fish behavior on fish detection and distribution.

OBJECTIVES

As part of a multi-investigator team, I am involved in completing the following project objectives:

1. Refine Fish LIDAR data processing techniques and test the results by a comparison with echo sounder, airborne video, trawl, and quantified aerial survey visual observation data. Particular attention will be paid to taxa identification in aerial surveys using LIDAR depolarization and school morphology.

2. Develop a technique to combine LIDAR, echo sounder, and sampling data to produce a species-specific measure of fish distribution. The first step will be to develop a technique to combine the data into a consistent index of abundance. We will then try to develop an accurate number density estimate.

3. Develop a technique to design the most accurate fish survey for a fixed cost. This will use adaptive sampling strategies where a low-cost LIDAR survey directs an echo sounder survey to the most productive regions within the habitat. The echo sounder survey, in turn, is used to design trawl placement to get the maximum amount of information.

4. Develop GIS-based techniques to quantitatively relate the distribution of epipelagic fishes to their habitat.

5. Develop expert system for LIDAR target identification using LIDAR return characteristics, video information, and habitat data.

My individual tasks involved assisting with survey design (Obj 3), developing a commercial fishing industry (fishermen, spotter pilots and processors) partnership to assist with the project (Obj 5), determining survey area (Obj 3), collection of flight log and visual survey data (Obj 1), comparison of

scientific lidar and acoustic data with data acquired from the commercial fishing industry (via spotter pilots) (Obj 5), and modeling the habitat data from scientific and commercial sources using GIS and spatial statistics (Obj 4).

WORK COMPLETED FY06

In FY06, my contributions resulted in the following accomplishments:

Task 10 (a): Prior to the field season, I communicated and coordinated with the fishing industry to organize spotter pilot cooperation, reporting of fishing and fish school activity and to obtain a platform for lidar calibration (part of year 1, task 1). A private vessel was obtained that allowed scientists to deploy the lidar calibration device in the ocean in coordination with lidar-instrumented airborne surveys. Calibration data was successfully obtained. During the field season, we maintained contact with the fishing industry for direction in setting up "adaptively sampled" areas pre-screened for fish concentrations. These areas were sampled in addition to the systematic and established study areas occupied by the research vessel. Visual data (fish schools, vessel activity, oceanic fronts, seabirds and marine mammals) was collected and compiled for the second year in a row.

Task 11 (c), Geostatistical analysis: although much of the data needed to accomplish this task has been compliled, this task remains incomplete because of additional time and decision-making necessary to fuse lidar, acoustic, visual and fishery data. This task requires efforts from all members of the group and is largely a synthesis effort appropriate for the final year of the project.

Task 12: Outreach was accomplished via a pre-season meeting with members of the fishing industry and via in-season visits and data exchange via with individual processing plants, fishing captains, and spotter pilots, In addition, I participated in the December, project-wide research meeting during which we discussed project finalization, analysis and reporting.

RESULTS

The main accomplishment for FY06 was the planning and collection of field data during the summer of 2006 and compilation of project related data. Compared to 2005, surface-schooling fish were relatively absent in the survey area and fishing activity was minimal. We were not able to cooperate with spotter pilot survey paths and individual fishery catch locations as we did in 2005. However, compilations of satellite data were completed in addition to fishery data collected from the fleet, from the processors, and from Oregon and Washington Departments of Fish and Wildlife. The proprietary information obtained from the agencies provides tonnage of fishery catches by exact location and time enabling interpretation of synoptic airborne instrument survey information. Specifically, these catches allow us to identify the key commercial fish species that are observed during our aerial flyovers.

The main results from this year, in combination with 2005 data, are the identification of optimal survey time for agency – industry cooperation and extractions of information from remote sensing. In order to maximize data sharing with the industry, the optimal survey period for the Pacific Northwestern United States is early July through the end of August. This is the period when fish behavior and condition result in the seasonal maxima in numbers and sizes of surface schools and therefore, the fleet is actively engaged and able to provide a large amount of information to synthesize with remotely sensed data for the region. From communications with the fleet, this period may be earlier for Northern

California waters but similar for British Columbia, Canada. In addition, the Columbia River plume may have an impact on commercial fish species distribution and is easily identifiable in SAR imagery. However, the 4 day gap between image acquisitions for the region does not allow for tracking of short-term variability in this front and it is not known how influential this variability is on fish distribution. Because wind direction and speed have a significant impact on the directional flow of the plume, easily obtained wind variables may serve as a proxy variable for determining plume effects on fish distribution.

Post-season review and the results of the recent research meeting have resulted in the following priorities for my part of the project during this final year:

1) Complete data extraction from satellite imagery to usable form including ascii files in txyz format with values of SST and ocean color (MODIS, SeaWiFS and AVHRR data) for direct comparison with airborne instrument data and extraction of ocean fronts and structure in a geo-located format for inclusion in the GIS synthesis and data analysis of habitat;

2) Inclusion of all fish school, sea bird, and marine mammal visual sighting data into the GIS database;

3) Delivery of commercial fishery catch data matching in time and place with lidar measurements and acoustic buoy measurements for scaling and interpretation of the remotely sensed data;

4) Summarize spotter pilot overflights with independent biomass estimates and geographically match lidar data for a comparison and indexing of the two data types; this may provide a useful index in the future if an airborne fishery assessment program can be implemented;

5) Take the lead on a paper comparing and recommending survey designs for fishery assessments based on the results of this study; the data collected during this project will allow a direct comparison of a fishery-based "adaptive sampling" design versus a typical oceanographic, systematic sampling survey.

RELATED PROJECTS

None